REMARKS

The Final Office Action mailed January 16, 2009 has been carefully considered. Reconsideration in view of the following remarks is respectfully requested.

Rejection(s) Under 35 U.S.C. §103(a)

Claims 1-3 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Kaneko et al. (U.S. pat. no. 5,932,990, hereinafter, "Kaneko") and further in view of Baldwin et al. (U.S. pat. no. 6,583,603; hereinafter, "Baldwin"). Applicants respectfully traverse.

The Office Action acknowledges the failure of Kaneko to disclose the claimed charging current limiting circuit and control circuit. The Office Action proposes to combine the teachings of Baldwin with those of Kaneko to cure this defect, stating that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to have had the teachings of Baldwin the device of Kaneko to have prevented the battery from receiving damaging excess recharge current levels … and for isolating the battery from load and the primary power supply." (Office Action, para. 6).

The presently claimed invention relies on a float charging approach, similarly to Baldwin. Specifically, in such an approach, the battery to be charged and the load are connected ***in parallel*** with respect to the DC power supply apparatus (rectifier). Turning to the charging current limiting circuit 4 of the present application, we see from claim 1 that the charging current limiting circuit 4 of the present application is "connected ***in series*** with said lithium ion battery and supplies a charging current of an arbitrary value independent of load fluctuations in the charging path of the lithium ion battery." (Emphasis added.)

The Office Action maintains that the rectifier 8 of Baldwin corresponds to the charging current limiting circuit 4 of the present application. However, this is not correct for the following reasons. First, from FIG. 1 of Baldwin, the rectifier 8 of is NOT connected to the battery strings 14 ***in series*** but is connected ***in parallel***. Therefore, in Baldwin, the charging current, which is output from the rectifier 8 and is supplied to the battery strings 14, depends on

fluctuations of the load 10 because the rectifier 8 is connected ***in parallel*** with battery strings 14 and with the load 10. On the other hand, the charging current limiting circuit 4 of the present application is connected ***in series*** with the lithium ion battery and supplies a charging current of an arbitrary value independent of load fluctuations in the charging path of the lithium ion battery, as explained above.

The Office Action asserts that the rectifier 8 of Baldwin corresponds to the charging current limiting circuit 4 of the present application based on the description from lines 5 to 9 of column 3 of Baldwin, in which it is stated that

> the rectifier 8 is equipped with a current limiting function. Current output by the rectifier 8 is limited to a predetermined maximum value that prevents the battery strings 14 from receiving damaging excess recharge current levels".

However, since the rectifier 8 of Baldwin is connected with the battery strings 14 and the load 10 ***in parallel***, the charging current supplied to the battery strings 14 depends on fluctuations of the load 10. Accordingly, Baldwin is not able to achieve the invention's above-described configuration and its effect—that is, the charging current limiting circuit 4 of the present application being "connected ***in series*** with said lithium ion battery and supplies a charging current of an arbitrary value independent of load fluctuations in the charging path of the lithium ion battery". Therefore, even if Kaneko were combined with Baldwin, this feature and effect of the invention would be realized or rendered obvious.

Furthermore, by closely studying the following passage from Baldwin, which is from line 66 of column 8 to line 51 of column 9 of Baldwin, the above-described citation of Baldwin in lines 5 to 9 of column 3 (***the rectifier 8 is…recharge current levels***), on which the Office Action bases the assertion that the rectifier 8 of Baldwin is equipped with a current limiting function, it can be seen that this merely describes a theoretical ideal (optimal) state that is not associated with a particular physical design. The passage reads as follows:

> Setting the current value to be significantly less than the I_{Boost} value and also monitoring the bus voltage is based on at least two concerns. In order to more fully understand these two concerns, however, a background discussion of optimal design

considerations is first in order. In an optimally designed system, taking into account battery protection, efficiency and economizing, ***the rectifier 8 is equipped with a current limiting function. Current output by the rectifier 8 is limited to a predetermined maximum value that prevents the battery strings 14 from receiving damaging excess recharge current levels***, as well as affording a smaller, more economical sizing of the rectifier 8. This limitation of recharge current occurs, at least in part, because the rectifier 8 is precluded from supplying enough current to both bring the voltage of the bus 12, 13 back to its nominal value (after resumption of power from the rectifier) and to supply large recharge currents to the battery strings 14. Moreover, this design constraint allows minimally sized components, thereby keeping the overall cost of the system at a minimum while still being capable of adequately handling the system power requirements.

Therefore, the first of previously mentioned concerns, in such an economically designed system, is that the voltage of the battery string 14 being charged may still be "low" when the recharge current merely falls below the I_{Boost} setpoint, thus indicating that the battery string has not been charged near its capacity. Hence, a float/$_{Boost}$ regulator that would be capable of charging batteries that are not yet charged to near their capacity (e.g., >90%) will be drastically oversized and have serious heat dissipation problems.

The second concern is that in an economically designed system, removing a battery string 14 when the recharge current is just at or immediately below the I_{Boost} level may cause the voltage of the bus 12, 13 to suddenly rise to nominal level due to the rectifier 8 coming out of current limit because the battery string(s) 14 is removed from direct bus recharging. Furthermore, activation of the float/$_{Boost}$ regulator 36 at this point in time may cause the rectifier 8 to reenter a current limiting mode due to the increased load (and, thus, current requirements) presented to the system by activation of the float/$_{Boost}$ regulator. Since the float/$_{Boost}$ regulator 36 is not 100% efficient, more current requirement would now be presented to the rectifier 8 by the float/$_{Boost}$ regulator 36, than when the battery strings 14 were being recharged directly from the bus 12, 13. Accordingly, the voltage of the bus 12, 13 would fall and may fall to such a point that the microcontroller(s) 38 will falsely detect a loss of power state requiring that the battery string(s) 14 to supply power to the load 10.

In light of the above concerns, the present system employs both monitoring of the bus voltage as well as setting a current transition point approximately 2/3 of the I_{Boost} value.

Therefore, the citation of Baldwin in lines 5 to 9 of column 3 (***the rectifier 8 is…recharge current levels***) does not relate to an actual configuration but rather to an ideal state. The actual configuration of Baldwin is is described in lines 48 to 50 of column 9, wherein it is stated that "In light of the above concerns, the present system employs both monitoring of the bus voltage as well as setting a current transition point approximately 2/3 of the I_{Boost} value. "

Moreover, in the float charging approach, unless the charging current limiting circuit 4 of the present application is provided in the charging path of the battery strings, it is not possible to define or limit the current value and so an excess current applies to the battery strings. Also, the constitution of Baldwin is similar to that of FIG. 10 of the present application, which relates to a conventional power supply system. Accordingly, conventional technical problems such as "After a power outage, in the case of power having been supplied from a DC power supply apparatus 112 such as a rectifier to a load device 113, current exceeding the allowable current value of the battery flows into the lithium ion battery 111, which has led to damage to the battery" as described in lines 18 to 21 of page 2 of the specification of the present application should would similarly beset Baldwin.

Therefore, the combination of Kaneko and Baldwin, fails to disclose or render obvious the presently claimed invention—to wit, the charging current limiting circuit 4, for instance—and is in any case beset with the above-described conventional problems leading to damage to the battery. For these reasons at least, the obviousness rejection based on these references is improper and it withdrawal is respectfully urged.

Conclusion

In view of the preceding discussion, Applicants respectfully urge that the claims of the present application define patentable subject matter and should be passed to allowance.

If the Examiner believes that a telephone call would help advance prosecution of the present invention, the Examiner is kindly invited to call the undersigned attorney at the number below.

Please charge any additional required fees, including those necessary to obtain extensions of time to render timely the filing of the instant Response to Office Action, or credit any overpayment not otherwise credited, to our deposit account no. 50-3557.

Respectfully submitted,
Nixon Peabody LLP

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